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Post-processing of Videos for Vehicle Counting

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creating and sharing knowledge for telecommunications

Content of the Presentation

- Motivation
- Proposed System Architecture
- Results
- Conclusions & Future Work

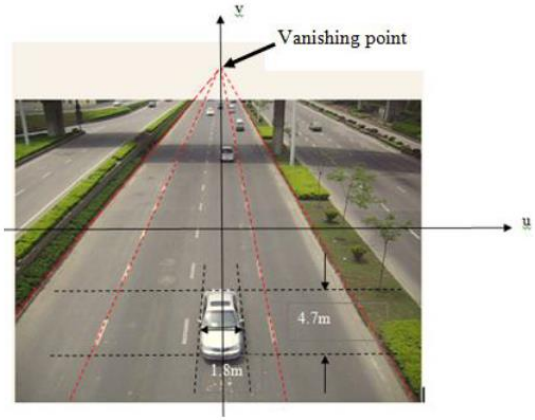
Motivation

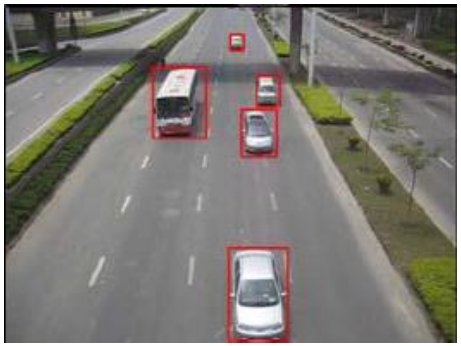
Through the use of traffic surveillance cameras:

- Create system to assess the traffic situation of specific locations
- Perform all the necessary parameterization for vehicle detection automatically

Image and Video Methods

- Motion-estimation-based methods



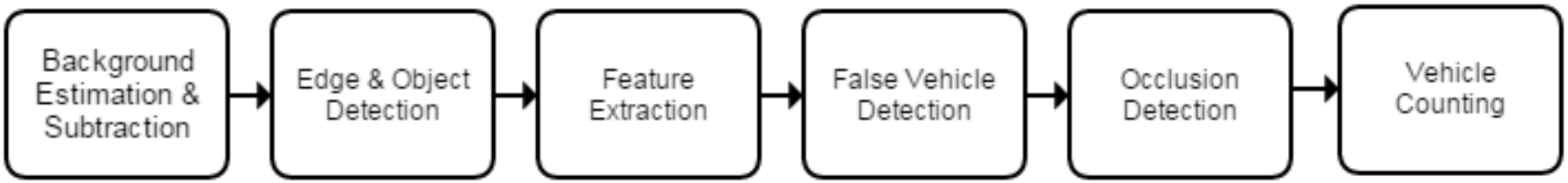


- Temporal-spatial methods

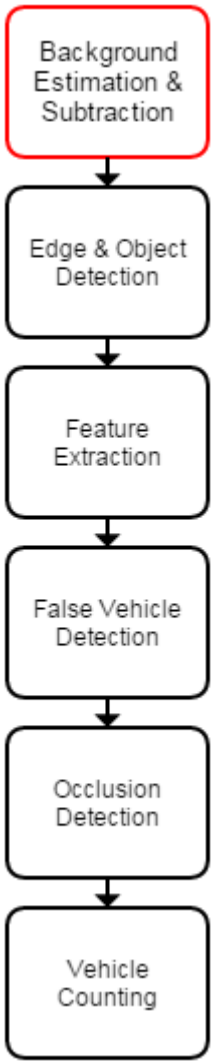
Temporal-spatial methods

- Virtual Detention Lines (VDLs)
- Temporal-Spatial Images (TSIs)

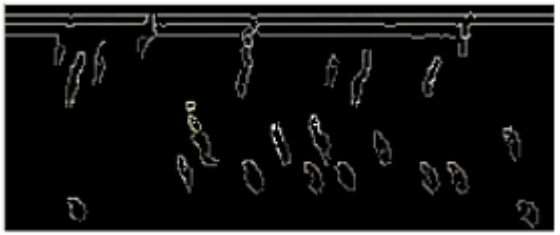
Proposed System Architecture



Background Estimation & Subtraction



Minimum variance method



Proposed method

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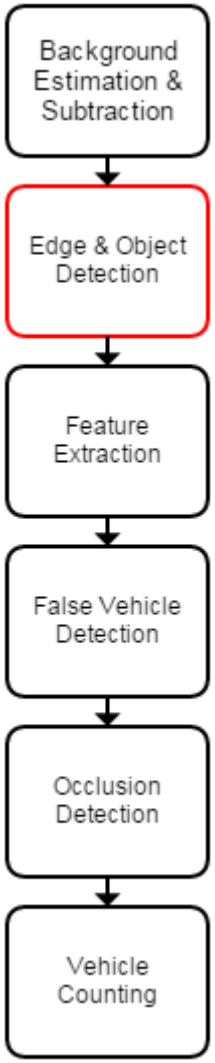
Edge & Object Detection

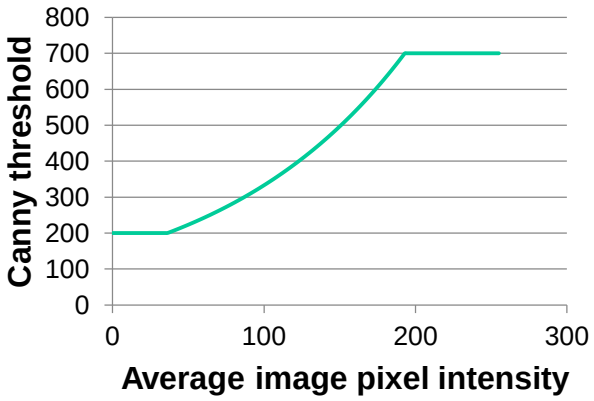


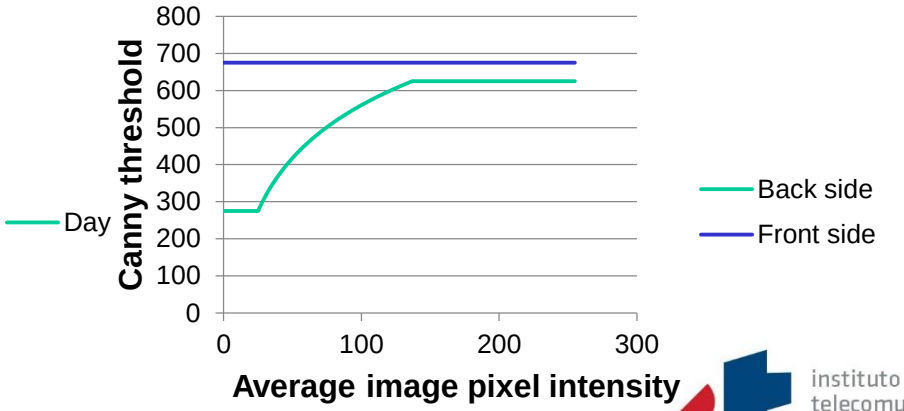
The detection is performed using a Canny edge detector

In order to improve the detection accuracy the video illumination is assessed

One of the 3 detection modes with automatically acquired parameters is used:

- Day Mode
- Night front side (NFS) mode
- Night back side (NBS) mode





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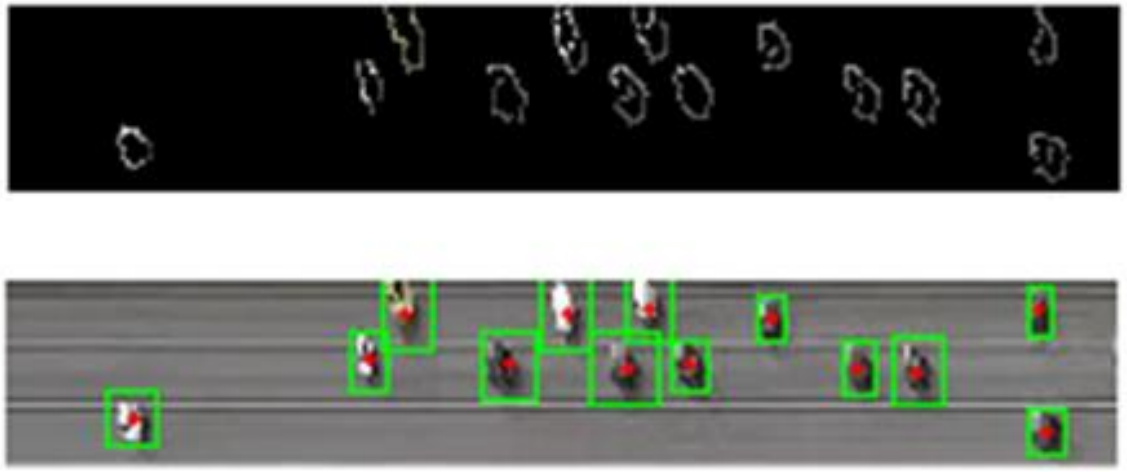
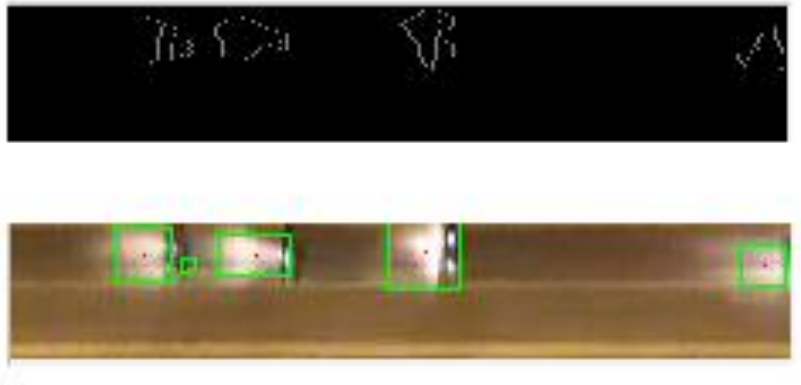
Day Mode - Example



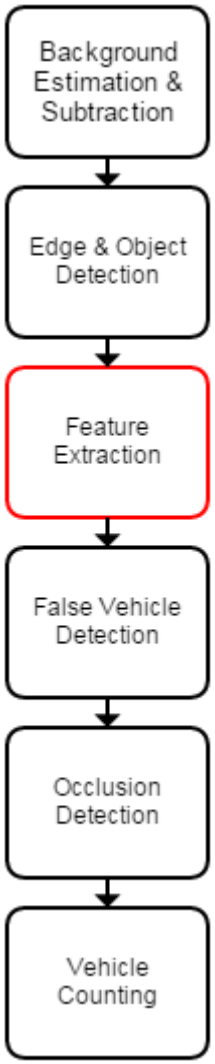
Night Modes - Examples

Back Side



Front Side

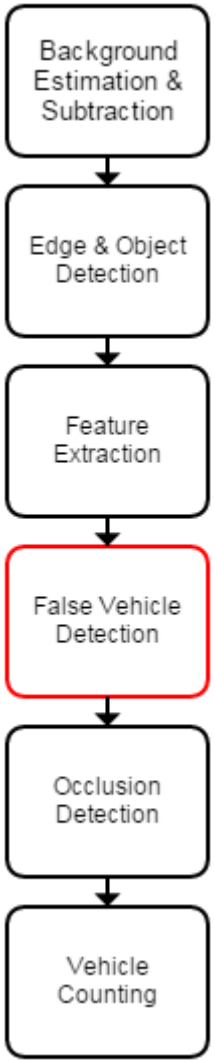
Feature Extraction



There are 3 features obtained from each object:

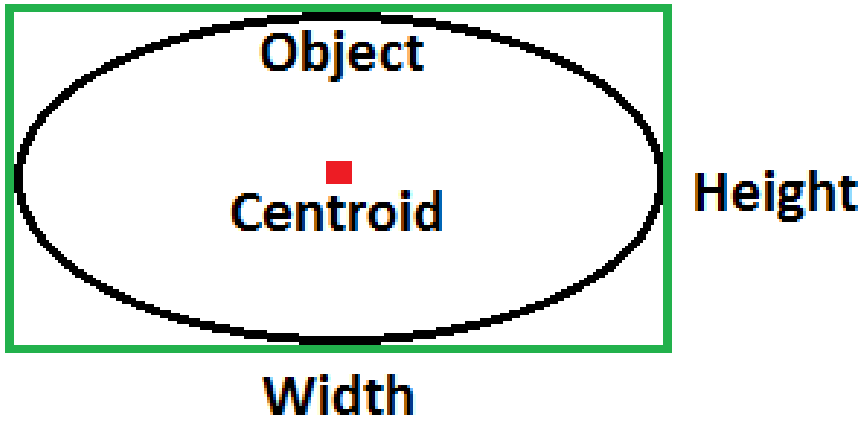
- Width
- Height
- Approximated centroid

False Vehicle Elimination

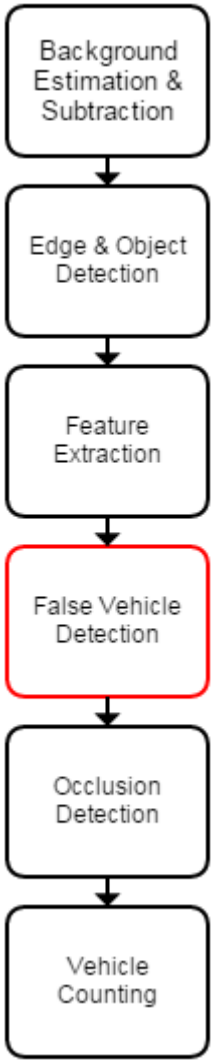


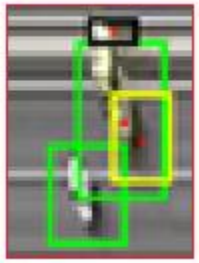
Set of verifications to reject objects based on:

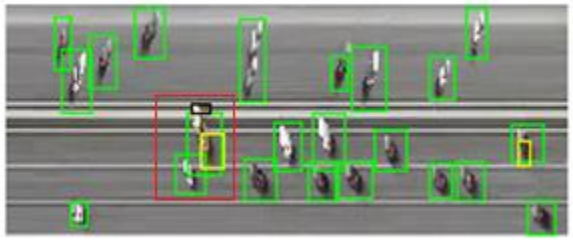
- Width and Height
- Area
- Overlapping objects' area

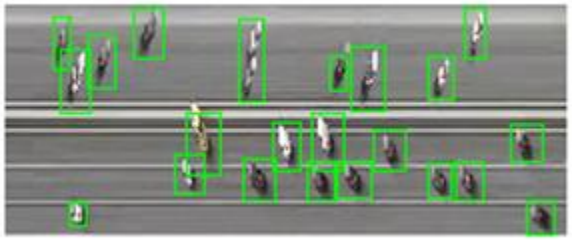


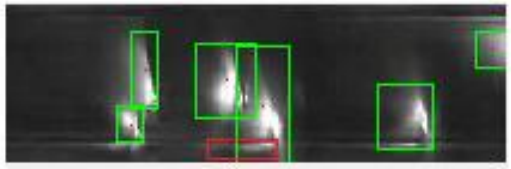
False Vehicle Elimination - Examples

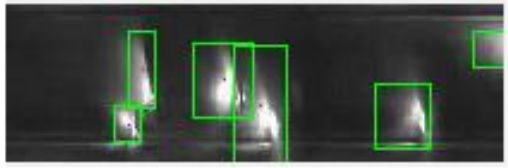






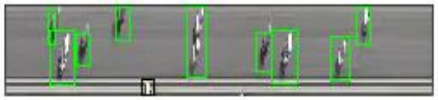


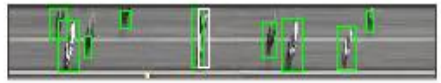


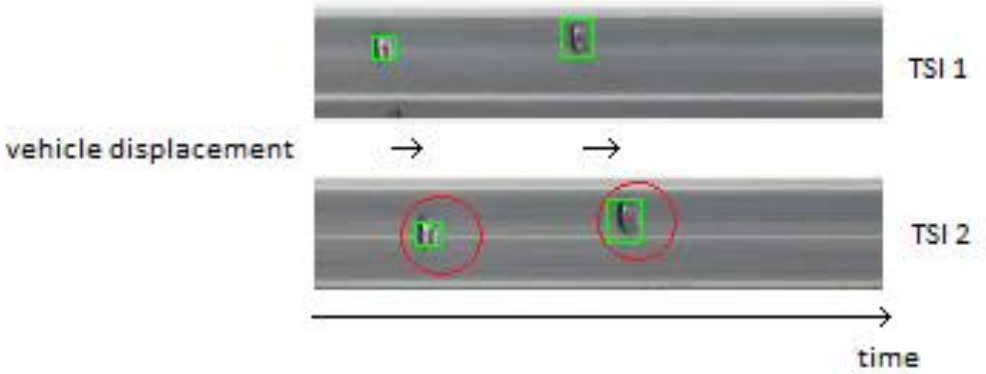


Occlusion detection

- Background Estimation & Subtraction
- Edge & Object Detection
- Feature Extraction
- False Vehicle Detection
- Occlusion Detection
- Vehicle Counting







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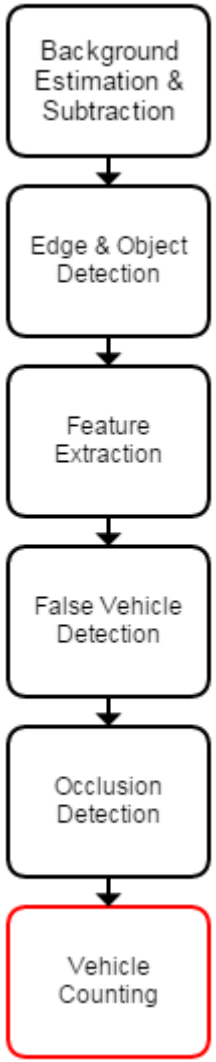
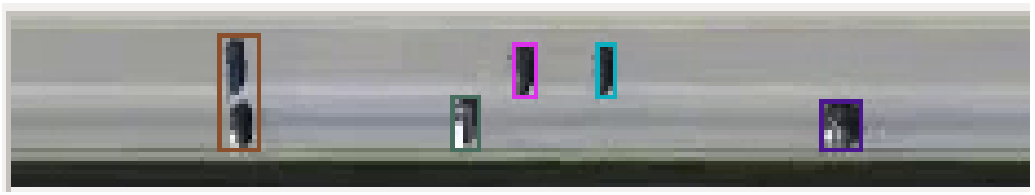
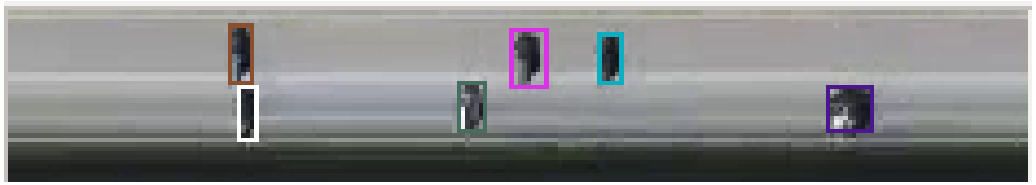
Vehicle Counting



$$v_{count} = o_{total} - o_{ignored} + o_{occluded}$$





Cumulative Data Treatment

- Uses the features' data from previously analyzed videos



Database of the Experiments

- Video streams from traffic surveillance cameras of Estradas de Portugal
- Low Resolution (200x200)
- Short duration (15 seconds)

Results – Day Mode

	Accuracy	Ground truth	Video sequences	Occlusions	Occlusions found
Good illumination	98.7%	155	20	7	6
Jitter	94.6%	146	20	9	8
Shadowed area	95.6%	91	10	10	9
Raining	91.8%	98	11	5	4
Blurred	94.2%	206	20	16	14
Moving camera	90.0%	129	17	9	6
Dusk	92.2%	207	20	13	10
Averages/Totals:	**93.8%**	**1032**	**118**	**68**	**56**

Results – Night Mode

	Accuracy	Ground truth	Video sequences	Occlusions	Occlusions found
NBSM - Good illumination	93.6%	111	20	8	6
NBSM – Blurred	90.6%	128	20	13	10
NBSM – Jitter	90.2%	143	20	8	5
NFSM - Good lighting	89.4%	114	20	1	1
NFSM – Blurred	90.6%	180	20	2	1
NFSM – Jitter	89.0%	135	19	0	0
Averages/Totals	**90.6%**	**811**	**119**	**32**	**23**

Results – More than 2 VDLs

	Accuracy			Occlusions	Occlusions found
Traffic	2 VDLs	3 VDLs	4 VDLs	Ground Truth	Number of videos
Low/Medium	96.1%	95.2%	94.0%	103	20
High	94.6%	96.4%	94.1%	264	20

Results - Cumulative Data

Number of videos	Accuracy with untrained data	Accuracy with trained data	Total number of vehicles counted on test videos
16	94.1%	97.1%	216

Results Comparison

Method	Accuracy	Vehicles counted	Ground truth
BSB [Rivlin, 2002]	86.2%	306	355
SVDL [Hue, 2009]	92.7%	329	355
SVDL [Rashid, 2010]	92.7%	329	355
SVDL [Santos, 2011]	96.7%	-	-
MVDL [Mithun, 2012]	98.3%	349	355
Proposed system	**98.6%**	292	296

[Mithun, 2012] – Niluthpol Chowdhury Mithun, Nafi Ur Rashid, and S. M. Mahbubur Rahman, “Detection and Classification of Vehicles From Video Using Multiple Time-Spatial Images,” in IEEE Transactions on Intelligent Tranportation Systems, Vol. 13, No.3, September 2012, pp. 1215-1224..

Conclusions

- The background estimation method developed allow a better column selection for the estimation
- High accuracy system on low resolutions video even at night
- The occlusion detection significantly improves the accuracy (Day - 81.1%) (Night - 71,9%)
- All the system decisions and detection parameters are made automatically

Future Work

- Take advantage of the color channels
- A better association method to use on more than 2 VDLs
- Use the object's width to estimate the vehicle velocity

Thank you!